Deficits and Real Interest Rates: A Note Extending the Hoelscher Model

Cebula, Richard and Scott, Gerald

Jacksonville University, Florida Atlantic University

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DEFICITS AND REAL INTEREST RATES : A NOTE EXTENDING THE HOELSCHER MODEL

RICHARD J. CEBULA* AND GERALD SCOTT*

I. Introduction

In a recent paper, Hoelscher (1986) finds that the federal budget deficit exercises a positive and significant impact on the *nominal* ten year Treasury note rate. Hoelscher (1986) works with a loanable funds model and estimates reduced-form equations by OLS, using the Cochrane-Orcutt procedure to correct for serial correlation.

The purpose of this brief note is to extend the Hoelscher (1986) analysis in at least two ways. First, we seek to examine the impact of the federal budget deficit on the *ex post* real (rather than nominal) long term interest rate. Second, unlike Hoelscher (1986), we allow for the endogeneity of the budget deficit and the real short term rate of interest.

II. Model

The basic Hoelscher (1986) model is given by :

$$NR=f\,(P,\ ERSR,\ Y,\ D,\ C) \qquad \ldots \quad (1)$$

where NR is the nominal interest rate yield on ten year Treasury notes; P is expected inflation; $ERSR$ is the expected real interest rate yield on short term Treasury obligations (bills); Y is the change in per capita real GNP; D is the federal deficit, measured either in per capita real terms or as a percentage of aggregate income; and C is real net capital flows from other countries into the United States.

The Hoelscher (1986) model, modified so as to enable us to examine the *ex post* real interest rate, is given by :

$$RR_t=a_0+a_1\ ARSR_t+a_2\ Y_t+a_3\ D_t+a_4\ C_t\ \mu \qquad \ldots \quad (2)$$

*Department of Economics, Florida Atlantic University, P. O. Box 3091, Bocaraton, Florida 33431—0991.

This model is quarterly, so that "t" refers to quarter "t" RR_t is the *ex post* real interest rate yield in quarter t on ten year Treasury notes; RR_t is computed by subtracting the actual inflation rate (P_t) from the nominal average interest rate yield on ten year Treasury notes (Ten_t). The term a_0 is a constant. Variable $ARSR_t$ is the *ex post* real interest rate yield in quarter t on three month Treasury bills, computed by subtracting P_t from the nominal average interest rate yield on three month Treasury bills ($Bill_t$). RR_t and $ARSR_t$ are both expressed as percents per annum. Y_t is the change in the per capita GNP in quarter t, expressed in 1982 dollars. D_t is the ratio of the federal budget deficit in quarter t (Def_t) to the middle-expansion trend GNP in quarter t (G_t), expressed as a percent. C_t is the ratio of the net flow of foriegn capital into the United States in quarter t (Cap_t) to the middle-expansion trend GNP in quarter t (G_t), expressed as a percent. Finally, μ is a strochastic error term. G_t, Cap_t, and Def_t are all expressed as seasonally adjusted annual rates. The time period examined runs from 1971 : 4 through 1987 : 4. We begin with 1971 : 4 because it is during this quarter that the system of fixed exchange rates (Bretton Woods) began to collapse.

The data for variable P_t come from the *Business Conditions Digest*, March 1988, p. 98. The data for Ten_t and $Bill_t$ come from the *Economic Report of the President*, as do the data for Y_t and Def_t. The data for Cap_t were obtained from the *Flow of Funds Accounts* of the Federal Reserve System. Finaly, the trend GNP data (G_t) come from Holloway (1986, Table 2) and the *Survey of Current Business*.

III. Results

Naturally, with the federal budget deficit included in the analysis, there arises the possibility of simultaneous-equation bias. This is because the budget deficit—by its very nature—is partly endogenous. Accordingly, equation (2) is estimated using an instrumental variables technique (as well as the Cochrane-Orcutt procedure, to correct for first-order serial correlation), with the instrument being the one-quarter lag of the seasonally adjusted unemployment rate of the civilian labor force, U_{t-1}. The choice of instrument is based on the fact that U_{t-1} systematically explains the budget deficit, wheras the contemporaneous error terms in the system are not correlated with U_{t-1}. In addition, to allow for endogeneity of the variable $ARSR_t$, we adopt a second instrumental variable : the one-quarter lag of the *ex post* real interest rate yield on Moody's Aaa-rated corporate bonds, $RMood_{t-1}$. The data for U_{t-1} and the nominal Moody's Aaa-rated corporate bond rate were obtained from the *Economic Report of the President*.

The 2 *SLS* estimate of equation (2) is given by :

$$RR_t = -3.37 + 0.785\ ARSR_t + 0.0003\ Y_t + 0.942\ D_t - 0.699\ C_t, \quad \ldots (3)$$
$$(+7.43) \qquad (+1.19) \quad (+3.96) \quad (-2.84)$$

$$DW = 1.74,\ Rho = 0.09$$

where terms in parentheses are t-values.

As shown in equation (3), the estimated coefficient on variable D_t is positive and statistically significant at beyond the one percent level. In addition, the estimated coefficient on variable C_t is negative and statistically significant at the one percent level. Thus, despite the interest-rate effects of international capital inflows, the budget deficit raises the *ex post* real interest rate yield on ten year Treasury notes.

Further more, this same conclusion is reached for other long term rates. For example, estimating equation (2) for the *ex post* real interest rate yield on 20 year Treasury bonds (RTR_t), rather than ten year Treasury notes, yields :

$$RTR_t = -3.27 + 0.627\ ARSR_t + 0.0003\ Y_t + 1.01\ D_t - 0.592\ C_t, \quad \ldots \quad (4)$$
$$(+5.07) \qquad (+1.14) \quad (+3.47) \quad (-2.02)$$

$$DW = 1.87,\ Rho = 0.03$$

As shown in equation (4), we observe that, despite the interest rate effects of capital inflows, the *ex post* real interest rate yield on 20 year Treasury bonds is an increasing function of the budget deficit.

IV. Concluding Remarks

Using a modified version of the Hoelscher (1986) model, this brief note provides evidence that the federal deficit exercises a positive and significant impact upon the *ex post* real long term rate of interest. Furthermore, it should be noted that estimates of alternative versions of Hoelscher's (1986) model yield this same conclusion. For instance, it can be shown that dropping variable $ARSR_t$ from the system and/or expressing D_t and C_t in billions of 1982 dollars and/or adding a variable to reflect Fed open market operations leaves intact our conclusion that the budget deficit raises the *ex post* real interest rate. Moreover, we can also generate this conclusion if we estimate in first difference form.

To illustrate these claims, consider the following system :

$$RR_t = b_0 + b_1\ Y_t + b_2\ RD_t + b_3\ RC_t + b_4\ M_t + \mu^* \quad \ldots \quad (5)$$

where RD_t is the deficit expressed in billions of 1982 dollars; RC_t is the net capital inflow expressed in billions of 1982 dollars; Y_t and RR_t are as above; and M_t is the net aquisition of credit market instruments by the Fed (expressed in billions of 1982 dollars). This version of the Hoelscher (1986) model drops variable $ARSR_t$ expresses the deficit and capital flow variables in real terms, and follows an earlier paper by Hoelscher (1983) by adding variable M_t to the system. Having dropped variable $ARSR_t$, we now deal with only one instrument, U_{t-1}.

Estimating equation (5) in first difference form by 2 SLS yields :

$$\Delta RR_t = 0.02 + \underset{(+1.15)}{0.0004}\ \Delta Y_t + \underset{(+2.3^{*})}{0.034}\ \Delta RD_t - \underset{(-1.25)}{0.008}\ \Delta RC_t \ldots \quad (6)$$
$$- \underset{(-1.67)}{0.002}\ \Delta M_t,\ DW = 1.76,\ Rho = 0.11$$

where "Δ" is the first difference operator. Once again, we observe that the coefficient on the deficit variable is positive and statistically significant and hence that the deficit raises the *ex post* real long term interest rate.

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